Effect of levels of Banana Marmalades on Quality of Stirred Yoghurt

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Abstract

The effect of levels of banana marmalades (BM) and storage period on quality of stirred yoghurt made from cow's milk was investigated. Starter culture 5% was added after the pasteurization of the milk at 85°C for 10 minutes. The milk was incubated at 45°C for four hours, thereafter cooled to the temperature of 6 ± 2°C, and BM at rate of 5%, 10%, 15% and 20% were added, The sugar at 8% were added for each levels of BM. The physicochemical, minerals, vitamins, and sensory evaluation were determined at storage intervals of 0, 4, 8, 12, and 16 days.

The physicochemical properties of stirred yoghurt found the highest total solids (36.0 %), protein (4.91%), ash (1.81%), fat (3.58%), carbohydrate,(24.0) fiber (1.71g/100g) and energy (759.56 K.Cal.) obtained by sample yoghurt containing 20% BM and the lowest total solids (21.2%), protein (4.21 %), ash (1.42%), fat (3.16 %), carbohydrates (12.22 %), fiber (0.19 g/100g) and energy (396.23 K.Cal.) by 5% BM. The total solids, protein, ash, carbohydrate, fiber and energy of stirred yoghurt increased with increasing levels of banana marmalades. The pH–values of all samples decreased significantly ($P \leq 0.05$) during storage period where the highest value (4.71) was recorded by sample 5 % and the lowest (4.24) by sample treated with 20% BM. The addition of BM has significantly ($p \leq 0.05$) decreased pH levels in all samples of stirred yoghurt. The titratable acidity increased significantly ($p \leq 0.05$) during storage period. The highest value (1.21 %) was obtained by 20 % BM and the lowest (0.89 %) by 5% BM. The mineral and vitamin contents increased with increasing levels of banana marmalades. The highest calcium, phosphorus, sodium, potassium, iron, magnesium, vitamin E and vitamin C (25.2,28.1 ,393 ,384 ,238 ,213 ,1.02 and 21.3 µg/100g) were obtained by 20 %BM, while the lowest value (17.2, 12.6,134 ,326 ,104 ,112 ,0.23 and 9.21 µg/100g) by sample 5 % BM.

The organoleptic quality reavled that, sample 15 % BM gave the best appearance (4.84) , texture (4.88), flavour (4.86) and overall acceptability (4.86) compared with other samples. The storage period significantly ($p \leq 0.05$) affected the quality of stirred yoghurt. The four sensory parameters gave the best qualities at the eighth day of the storage period and the worst at the end..

Key words : Stirred yoghurt , Banana Marmalades, physicochemical, storage period.

المستخلص:

تم دراسة تأثير مستويات مربى الموز (BM) وفترة التخزين على جودة الزبادي المخلوط المصنوع من حليب البقر. تمت إضافة الثقافة البادئة 5٪ بعد بسترة الحليب عند 85 درجة مئوية لمدة 10 دقائق. تم تحضين الحليب عند 45 درجة مئوية لمدة أربع ساعات ، وبعد ذلك تم تبريده إلى درجة حرارة 6 ± 2 درجة مئوية ، وتم إضافة BMبمعدل 5٪ ، 10٪ ، 15٪ و 20٪، أضيف السكر عند 8٪ لكل مستويات BM. تم تحديد التقييم الفيزيائي والكيميائي والمعادن والفيتامينات والحسية على فترات تخزين 0 ، 4 ، 8 ، 12 ، 16 يوم .وجدت الخواص الفيزيائية والكيميائية للزبادي المخفوق أعلى المواد الصلبة الكلية (36.0٪) ، البروتين (4.91٪) ، الرماد (1.81٪) ، الدهون (3.58٪)، الكربوهيدرات ، (24.0) الألياف (1.71 جم / 100 جم) والطاقة (759.56) .K.Cal). تم الحصول عليها من عينة الزبادي المحتوية على 20٪ BMوأقل المواد الصلبة الكلية (21.2٪)، البروتين (4.21٪)، الرماد (1.42٪) ، الدهون (3.16٪) ، الكربوهيدرات (12.22٪) ، الألياف (0.19) جم / 100 جم) والطاقة (396.23 كيلو كالوري) بنسبة 5٪ وزن الجسم. زادت المواد الصلبة الكلية والبروتين والرماد والكربوهيدرات والألياف وطاقة الزبادي المخفوق مع زيادة مستويات مربى الموز. انخفضت قيم الأس الهيدروجيني لجميع العينات معنوياً (P 0.05) خلال فترة التخزين حيث سجلت أعلى قيمة (4.71) بالعينة 5٪ وأدنى (4.24) بالعينة المعالجة بـ 20٪ BM.أدت إضافة BM إلى انخفاض معنوي (p 0.05)في مستويات الأس الهيدروجيني في جميع عينات الزبادي المخفوق. زادت حموضة المعايرة معنويا (p 0.05) خلال فترة التخزين. أعلى قيمة (1.21٪) حصلت عليها 20٪ BMوأقلها (0.89٪) بنسبة 5٪ .BMزادت محتويات المعادن والفيتامينات مع زيادة مستويات مربى الموز. تم الحصول على أعلى نسبة من الكالسيوم والفوسفور والصوديوم والبوتاسيوم والحديد والمغنيسيوم وفيتامين هـ وفيتامين ج (25.2 و 28.1 و 393 و 384 و 238 و 213 و 1.02 و 21.3 ميكروغرام / 100 جم) بنسبة 20٪ BM، بينما أقل قيمة (17.2 ، 12.6 ، 134 ، 326 ، 104 ، 112 ، 0.23 و 9.21 ميكروغرام / 100 جم) حسب العينة 5٪ .BMاختلفت الجودة الحسية، حيث أعطت العينة 15٪ BMأفضل مظهر (4.84) ، والملمس (4.88) ، والنكهة (4.86) ، والقبول الكلي (4.86) مقارنة بالعينات الأخرى ، وأثرت فترة التخزين معنويا (p 0.05) على الجودة. من اللبن الزبادي المخفوق. أعطت المعلمات الحسية الأربعة أفضل الصفات في اليوم الثامن من فترة التخزين والأسوأ في النهاية .. الكلمات المفتاحية: الزبادي المخفوق ، مربى الموز ، فيزيائي-كيميائي ، فترة التخزين.

Introduction

Fermentation is one of the old and safety methods for preserving milk. The increase in acidity consequent to fermentation results in products such as yoghurt, quarg, labneh, kefir and koumiss, which are bacteriologically stable under refrigerated conditions and free from pathogens.

Fermented dairy foods have long been considered safe and nutritional. The health b enefits elicited by lactic acid bacteria (LAB) involved in the production of these foods were the primary reason to associate the consumption of yoghurt. The lactic acid lowers the pH and makes it start and causes the milk protein to thicken. The fermented milk makes yoghurt easily digestible. (Bashir, 2010).

A banana is an edible fruit produced by several kinds of large herbaceous flowering pl ants of the genus Musa. In some countries, bananas used for

cooking may be called plantains (Valmayor *et al.,*2000). The fruit is variable in size, colour and firmness, but is usually elongated and curved, with soft flesh rich in starch covered with a rind which may be yellow, purple or red when ripe (Nelson *et al*.,2006). The fruits grow in clusters hanging from the top of the plant. Almost all modern edible parthenocarpic (seedless) bananas come from two wild species – *Musa acuminata* and *Musa balbisiana* (Ploetz *et al*., 2007).

The objective of this investigation is to study the effect of levels of banana marmalades on quality of stirred yoghurt.

Materials and Methods

Materials

Source of cow's milk and banana fruit

Fresh raw cow's milk and banana fruit (*Musa coccinea*) were obtained from the local market, Khartoum North, Sudan.

Source of starter culture and plastic cups

The starter culture *Lactobacillus bulgaricus* and *Streptococcus thermohpilus* were obtained from Premier Food and Juice Products Company Ltd. Plastic cups (250 ml size) were purchased from the local market.

Methods

Preparation of banana fruit

The banana fruit was peeled and cut to marmalades using sharp clean stainless steel Knives.

Manufacture of yoghurt

Four plastic containers selected in which fresh cow's milk was kept in equal volumes after being filtered from impurities. The milk was pasteurized at 85˚C for 10 minutes, and then cooled to 45^{0}C. Thereafter, the milk was placed into 250 ml cups and kept in an incubator at 45˚C for 3-4 hours. After that The yoghurt was mixed with four levels (5%, 10% ,15% and 20%) of banana marmalades and then equal volume of sugar (8%) were added. The cups were transferred to the refrigerator (10^{o}C) and stored for 0, 4, 8, 12 and 16 days intervals. Determinations were carried out for physicochemical, vitamins ,minerals, and organoleptic qualities.

Physicochemical analyses

The pH-value was determined by using digital pH meter model A005673-3-5, While the titratable acidity, total solid, protein and fat contents were determined according to AOAC (1990). The carbohydrates, fiber and energy value were determined according to James (1995). Vitamin C determined according to (Haroun,1998). Vitamin E determined by HPLC method according to Syvaoja *et al.,* (1985) Minerals content were determined

according to Atomic Absorption Spectrometer (Perkin Elmer, 1994).

Sensory Evaluation

Ten panelists from the Department of Food Science and Technology of AL Zaeim AL Azhari University were chosen to judge on the quality of yoghurt in term of appearance, texture, flavuor and acceptability. The sensory evaluation was evaluated by scoring procedure, headonic scale as described Ihekoronye and Ngoddy (1985).

Statistical analysis

Each treatment was performed in three replications. All data are presented as the Mean ± Standard Deviation (SD). After verifying normality of variables, ANOVA analysis followed by Duncan post-hoc test for multiple comparisons were done at significant level of 0.05 ($p<0.05$). All analysis was performed using the SPSS V.16 software package (Lisazoian and Joarusti, 1995).

Results and Discussion

Physicochemical properties of stirred yoghurt

Total solid

Table 1. shows the effect of levels of banana marmalades (BM) on total solid content of stirred yoghurt. The highest total solid content (36.0%) was obtained by sample containing 20% BM, and the lowest (21.20%) by sample 5% BM, while the other samples ranked in intermediate positions ($P\leq0.05$). The total solid was increased with increasing levels of BM. Abdel-Salam, (1996) found that, the total solids content decreased during storage period, a decrease in all samples due to lactose fermentation, protein and fat hydrolysis with formation of volatile substance. Ahmed *et al*., (2010) found the total solid of frozen yoghurt with different levels of banana 10%,12% and 14%were 38.03%, 37.5% and 37.9% respectively.

Protein content

Table 1. shows the effect of levels of banana marmalades (BM) on protein content of stirred yoghurt. The highest protein content (4.91%) was obtained by sample containing 20% BM and the lowest (4.21%) by sample 5%, while the other samples ranked in intermediate ($P\leq0.05$). The protein content was increased with the increasing levels of BM.

The addition of fruit caused an increase in protein content of yoghurt (Yousef *et al.,* 2013). The protein of banana powder was 4g per 100g (USDA, 2010).

Fat content

Table 1. shows the effect of levels of banana marmalades (BM) on fat content of stirred yoghurt. The highest fat content (3.58%) was obtained by sample containing 20% BM, and the lowest (3.16%) by sample 5% BM, while the other samples ranked in intermediate positions ($P\leq0.05$). The fat content increased with the increasing levels of BM.

Ahmed *et al*., (2010) found the fat content of frozen yoghurt with different levels of banana 10%,12% and 14% were 1.83%, 1.66% and 1.80% respectively. Peiman *et al*. ,(2011) stated that the fat of the fruity yoghurt with banana flavour was 9%. Bananas have tryptophan, and amino acid that helps to body produce serotonin (Valmayor *et al.,*2000). USDA(2010) reported that, the fat content of banana powder was 2g per 100g.

Ash content

Table 1. shows the effect of levels of banana marmalades (BM) on ash content of stirred yoghurt. The highest ash content (1.81%) was obtained by sample 20% BM, and the lowest (1.42%) by sample 5% BM, while the other samples ranked in intermediate positions (P≤0.05). The ash content increased with the increasing level of BM.

Cow milk contained 0.71 ash (Ghada, 2002). Hafiz (2013) stated the highest ash content (1.60%) was obtained by sample 12% banana powder, and the lowest (1.30%) by the control sample, while the other samples ranked in intermediate positions (P≤0.05). The ash content increased with the increasing levels of BM.

Available carbohydrate

Table 1. shows the effect of levels of banana marmalades (BM) on available carbohydrate of stirred yoghurt. The highest carbohydrate (24.00%) was obtained by sample containing 20% BM, and the lowest (12.22%) by sample 5% BM, while the other samples ranked in intermediate positions (P≤0.05). The carbohydrate increased with the increasing levels of BM.

The addition of fruit caused an increase in carbohydrate of yoghurt (Yousef *et al.,* 2013). Bananas have a healthy level of carbohydrates that are perfect for amuch energy boot (Valmayor *et al.,*2000). Their caloric content will keep you energized, but make sure to not overeat since the sugar and carbohydrate content is high (Ploetz *et al.,*2007). The addition of fruit caused an increase in carbohydrate and protein content of yoghurt. The results revealed that with the addition of banana fruit pulp, the lactose content significantly increased. This might be due to the presence of reducing sugar in banana (Morvarid *et al.,* 2013). The carbohydrate of banana powder was 88g per 100g (USDA, 2010).

Fiber content

Table 1. shows the effect of levels of banana marmalades (BM) on fiber content of stirred yoghurt. The highest fiber (1.71%) was obtained by sample containing 20% BM, and the lowest (0.19%) by sample 5% BM, while the other samples ranked in intermediate positions (P≤0.05). The fiber content increased with the increasing levels of BM.

Valmayor *et al.,*(2000) noticed that the bananas are high in fiber that helps regulate your digestive system. Mata *et al*.,(2000) found the banana fruit contains considerable amount of fiber. The banana plant has long been a source of fiber for high quality textiles (Ploetz *et al.,*2007). The fiber of banana powder was 10 g per 100g (USDA, 2010).

Energy

Table1. shows the effect of level of banana marmalades (BM) on energy of stirred yoghurt. The highest energy (759.56 K.Cal) was obtained by sample containing 20%BM, and the lowest (396.23 K.Cal) by sample 5% BM, while the other samples ranked in intermediate positions (P≤0.05). The energy increased with the increasing levels of BM.

Bananas have a healthy level of carbohydrates that are perfect for much energy boot (Valmayor *et al.,*2000). Their caloric content will keep you energized, but make sure to not overeat since the sugar and carbohydrate content is high (Ploetz *et al.,*2007).

Table 1. Effect of levels of banana marmalades on physicochemical properties (%) of stirred yoghurt

Item	Levels of banana marmalades (%)			
	5	10	15	20
Total solid	$21.20^{d}\pm0.09$	$26.10^{c}\pm0.04$	$30.80^{b}\pm0.02$	$36.00^{a}\pm0.07$
Protein content	$4.21^{d}\pm0.06$	$4.46^{c}\pm0.05$	$4.67^{b}\pm0.08$	$4.91^{a}\pm0.09$
Fat content	$3.16^{d}\pm0.11$	$3.31^{c}\pm0.12$	$3.44^{b}\pm0.13$	$3.58^{a}\pm0.15$
Ash content	$1.42^{d}\pm0.02$	$1.55^{c}\pm0.06$	$1.69^{b}\pm0.08$	$1.81^{a}\pm0.07$
Available carbohydrate	$12.22^{d}\pm0.11$	$16.15^{c}\pm0.12$	$19.28^{b}\pm0.15$	$24.0^{a}\pm0.13$
Fiber (g / 100g)	$0.19^{d}\pm0.08$	$0.63^{c}\pm0.13$	$1.12^{b}\pm0.14$	$1.71^{a}\pm0.16$
Energy (K.Cal.)	$396.23^{d}\pm0.13$	$472.84^{c}\pm0.17$	$534.43^{b}\pm0.18$	$759.56^{a}\pm0.15$

- Mean ± SD. values having different superscript letters in rows are significantly different (p≤0.05).

Effect of levels of banana marmalades on pH value and treatable acidity
pH value

Table2. shows the effect of levels of banana marmalades (BM) on pH value of stirred yoghurt. The highest pH value (4.71) was obtained by sample containing 20% BM, and the lowest (4.24) by sample 5% BM, while the other samples ranked in intermediate positions (P≤0.05). Storage period significantly (P≤0.05) affected the pH value of set yoghurt .The highest value obtained at the beginning of storage period while the lowest at the end.

The results may be due to acid production in the yoghurt during storage as a result of lactose fermentation. the pH of all yoghurt samples decreased during storage time. It means the highest of pH related to the first day of production with limit (4.1-4.6) and the lowest of pH related to the tenth day with limit (3.3-4.1) (Morvarid *et al.,* 2013). Hashim *et al*.,(2009) found the pH of yoghurt ranged from 4.3 to 4.5 Peiman *et al.* ,(2011) found the pH value of the yoghurt banana flavoured from 4.11 to 9 .6 in sixth day. Ahemed (2010) concluded the pH of banana frozen yoghurt were 4.26 and 4.06. Songul *et al*., (2010) found the pH value of juice flavoured yoghurt decreased during 14 days of storage.

Titratable acidity

Table2. shows the effect of levels of banana marmalades (BM) on titratable acidity of stirred yoghurt. The highest titratable acidity (1.01%) was obtained by sample containing 20%BM, and the lowest (0.89%) by sample 5%, while the other samples ranked in intermediate positions (P≤0.05). The titratable acidity was increased with increasing levels of BM.

The addition of fruit marmalade increased the acidity of fruit yoghurt and acidity was increased with the increasing of fruit pulp added (Morvarid *et al.,* 2013). Songul *et al*., (2010) found the titratable acidity was increased during the storage period of the probitotic banana yoghurts and significant differences were found between the control and other yoghurt samples. Ozturk and Oner (1999) also reported that, the titratable acidity of grape juice –flavored yoghurt increased after 7 days of storage at 4 C^{o} and paralleled the change in titratable acidity. Titratable acidity in all samples increased progressively during storage period (Galal *et al*., 2004 and Guod *et al*., 2004), it refers to an increase in lactic acid by starter culture. Hofi *et al*. (1978) and Salih and Ismail (1985) found that, the increase in titratable acidity may be due to the active and pure starter culture used, and to extend storage after manufacturing. Hashim *et al*.,(2009) stated that, the titratable acidity ranged from 0.98 to 1.16% of set yoghurt.

Effect of levels of banana marmalades and storage period on minerals and vitamins of stirred yoghurt

Table 3. shows the effect of levels of banana marmalades (BM) on minerals and vitamins of stirred yoghurt. The highest calcium (25.2 µg/100g), phosphorus (28.1 µg/100g), sodium (393µg/100g), potassium (384 µg/100g), iron (238 µg/100g), magnesium (213 µg/100g), vitamin E (1.02 µg/100g) and vitamin C (21.3 µg/100g) were obtained by sample containing 20% BM, and the lowest calcium (17.2 µg/100g), phosphorus (12.6 µg/100g), sodium (134g/100g), potassium (326 µg/100g), iron (104 µg/100g), magnesium (112 µg/100g), vitamin E (0.23 µg/100g) and vitamin C (9.21 µg/100g) by sample 5%, while the other samples ranked in intermediate positions ($P \leq 0.05$). The minerals and vitamins were increased with increasing levels of banana marmalades.

Table 2 .Effect of levels of banana marmalades and storage period on pH value and titratable acidity (% lactic acid) of stirred yoghurt.

Table 2 .Effect of levels of banana marmalades and storage period on pH value and titratable acidity (% lactic acid) of stirred yoghurt.

Item	pH value				Titratable acidity			
	Levels of banana marmalades (%)				Levels of banana marmalades (%)			
Storage period (days)	5	10	15	20	5	10	15	20
0	$4.71^{a}\pm0.06$	$4.68^{b}\pm0.08$	$4.66^{ab}\pm0.05$	$4.63^{cd}\pm0.09$	$0.89^{m}\pm0.08$	$0.91^{L}\pm0.11$	$0.94^{k}\pm0.13$	$0.96^{J}\pm0.15$
4	$4.64^{c}\pm0.11$	$4.61^{d}\pm0.12$	$4.59^{h}\pm0.07$	$4.54^{fg}\pm0.13$	$0.96^{J}\pm0.09$	$0.99^{i}\pm0.07$	$1.01^{h}\pm0.06$	$1.03^{g}\pm0.04$
8	$4.58^{e}\pm0.04$	$4.55^{f}\pm0.03$	$4.52^{g}\pm0.02$	$4.49^{h}\pm0.15$	$1.01^{h}\pm0.05$	$1.03^{g}\pm0.13$	$1.06^{ef}\pm0.03$	$1.08^{d}\pm0.12$
12	$4.46^{i}\pm0.16$	$4.44^{i}\pm0.18$	$4.39^{Jk}\pm0.17$	$4.34^{L}\pm0.19$	$1.04^{f}\pm0.12$	$1.07^{e}\pm0.13$	$1.08^{d}\pm0.16$	$1.11^{c}\pm0.08$
16	$4.40^{J}\pm0.08$	$4.38^{k}\pm0.06$	$4.32^{L}\pm0.11$	$4.24^{m}\pm0.13$	$1.08^{d}\pm0.05$	$1.10^{c}\pm0.06$	$1.18^{b}\pm0.08$	$1.21^{a}\pm0.09$

- Mean ± SD. values having different superscript letters in columns and rows are significantly different ($p\leq0.05$).

Mata *et al*.,(2000) found the banana fruit contain considerable amount of minerals and vitamins. Peiman *et al*.,(2011) concluded that the calcium of yoghurt is absorbed in body faster than milk, because lactic acid of yoghurt turns calcium to solution and absorbtion therefor ,yoghurt devotes calcium to body more than milk. Hafiz (2013) stated that, the highest phosphorus (21 µg/100g) was obtained by sample (12%) banana powder, and the lowest (6 µg/100g) was obtained by (0%) banana powder, while the other samples ranked in intermediate positions (P≤0.05). The phosphorus was increased with increasing the levels of banana powder.

Ploetz *et al.,(*2007) noticed the banana fruit was low in sodium. Ploetz *et al.,(*2007) noticed the bananas are good source of potassium and vitamins. Banana provide avariety of nutrient including potassium. Peiman *et al*. ,(2011) reported that the adding difference furit juices to yoghurt increases some minerals suchas Mg ,Zn ,Fe ,Cu. The calcium, sodium, iron, vitamin E and vitamin C were 2%, 3 mg, 6%, 0.39 and 11% per 100 g respectively (USDA, 2010).

Effect of level of banana marmalades on organoleptic quality of the set yoghurt

Appearance

Table 4. shows the effect of levels of banana marmalades (BM) on appearance of stirred yoghurt. The highest appearance (4.84) was obtained by sample containing 15% BM, and the lowest (4.18) was obtained by sample 20% BM, while the other samples ranked in intermediate positions (P≤0.05).

Appearance mean scores of yoghurt decreased prolonging the cold storage period (Mervat *et al*., 2007). Chen *et al*., (1984) reported that, the appearance recorded high score in the beginning of the storage period. Ahmed *et al*.,(2010) found the best of appearance of banana frozen yoghurt (7.93) was obtained by sample 14% banana.

Texture

Table 4. shows the effect of levels of banana marmalades (BM) on texture of stiirred yoghurt. The highest texture (4.88) was obtained by sample containing 15% BM, and the lowest (4.21) was obtained by sample 20%BM, while the other samples ranked in intermediate positions (P≤0.05).

Yoghurt prepared with stabilizer ranked higher score for texture and appearance compared to the control yoghurt. This trend of results was also recorded during storage (Elshibiny *et al*., 1987; Mervat *et al*., 2007). Chen *et al*., (1984) found that, the high level of total solid improve the body and texture of yoghurt. Producing fermented milk products may be difficult because of the problem of milk coagulation. Yoghurt texture is a very important characteristic

that affects its quality (appearance, mouthfeel, and overall acceptability). In an attempt to increase firmness and prevent syneresis, stabilizers and hydrocolloids have been added to yoghurt (Keogh and O'Kennedy, 1998). Ahmed *et al*.,(2010) found that, the best texture of banana frozen yoghurt was obtained by sample containing 10%banana powder.

Table 3. Effect of levels of banana marmalades on mineral and vitamin contents (µg/100g).

Item	Levels of banana marmalades (%)			
	5	10	15	20
Calcium	17.20^{d}±0.05	19.60^{c}±0.09	21.70^{b}±0.07	25.20^{a}±0.06
Phosphorus	12.60 ^{d}±0.08	16.20^{c}±0.02	22.40^{b}±0.03	28.10^{a}±0.14
Sodium	134^{d}±0.11	203^{c}±0.13	298^{b}±0.15	393^{a}±0.12
Potassium	326^{d}±0.09	337^{c}±0.12	359^{b}±0.17	384^{a}±0.16
Iron	104^{d}±0.06	143^{c}±0.08	205^{b}±0.03	238^{a}±0.05
Magnesium	112^{d}±0.12	137^{c}±0.14	169^{b}±0.16	213^{a}±0.18
Vitamin E	0.23^{d}±0.03	0.48^{c}±0.06	0.71^{b}±0.09	1.02^{a}±0.04
Vitamin C	9.21^{d}±0.07	12.90^{c}±0.05	16.20^{b}±0.02	21.30^{a}±0.08

Mean ± SD. values having different superscript letters in • rows are significantly different (p≤0.05).

Flavour

Table 4. shows the effect of levels of banana marmalades (BM) on flavour score of stirred yoghurt. The highest flavour (4.86) was obtained by sample 15%BM, and the lowest (3.91) by sample 20%BM, while the other samples ranked in intermediate positions (P≤0.05).

Ahmed *et al*.,(2010) found the best flavor score of banana frozen yoghurt was obtained by14%banana powder. In addition ,banana puree is used in

fruit- flavoured yoghurt production (Hull *et al*.,1984). Songul *et al*.,(2010) found the beginning of storage all yoghurts were superior, mainly because of their more intense and better consistency. However ,after 7days, the acidity of the yoghurts increased and the sensory scores of all sample begin to decrease.

Over all acceptability

Table 4. shows the effect of levels of banana marmalades (BM) on over all acceptability of stirred yoghurt. The highest over all acceptability (4.86) was obtained by sample containing 15% BM, and the lowest (4.03) by sample containing 20% BM, while the other samples ranked in intermediate positions ($P \leq 0.05$).

Ahmed *et al*.,(2010) found the best score over all acceptability of banana frozen yoghurt was obtained by 14% banana .Songul *et al*.,(2010) found the overall acceptability scores of banana yoghurts increased during storage for up to 7 days, and then decreased. This could be attributed to the development of acidity. Yoghurt texture is a very important characteristic that affects its quality (appearance, mouthfeel, and overall acceptability). In an attempt to increase firmness and prevent syneresis, stabilizers and hydrocolloids have been added to yoghurt (Keogh and O'Kennedy, 1998).

Table 4. Effect of levels of banana marmalades and storage period on organoleptic quality of stirred yoghurt.

Table 4. Effect of levels of banana marmalades and storage period on organoleptic quality of stirred yoghurt.

Item	Appearance				Texture				Flavour				Over all acceptability			
	Levels of banana marmalades (%)				Levels of banana marmalades (%)				Levels of banana marmalades (%)				Levels of banana marmalades (%)			
Storage period (days)	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20
0	4.32^{J} ±0.15	4.57^{ef} ±0.09	4.63^{d} ±0.12	4.20^{L} ±0.08	4.37^{k} ±0.08	4.61^{g} ±0.13	4.74^{d} ±0.15	4.21^{o} ±0.14	4.41^{i} ±0.11	4.56^{g} ±0.13	4.76^{d} ±0.15	4.23^{L} ±0.18	4.42^{iJ} ±0.09	4.72^{f} ±0.14	4.76^{e} ±0.16	4.21^{m} ±0.09
4	4.46^{g} ±0.07	4.62^{d} ±0.09	4.78^{b} ±0.08	4.32^{J} ±0.11	4.42^{i} ±0.11	4.69^{f} ±0.09	4.82^{b} ±0.03	4.32^{m} ±0.08	4.46^{h} ±0.16	4.62^{f} ±0.18	4.79^{c} ±0.13	4.33^{k} ±0.11	4.45^{h} ±0.12	4.79^{d} ±0.03	4.82^{b} ±0.06	4.28^{L} ±0.08
8	4.51^{f} ±0.06	4.68^{c} ±0.02	4.84^{a} ±0.01	4.46^{g} ±0.03	4.49^{h} ±0.05	4.75^{c} ±0.07	4.88^{a} ±0.01	4.40^{J} ±0.06	4.53^{g} ±0.15	4.71^{e} ±0.11	4.86^{a} ±0.02	4.37^{Jk} ±0.07	4.47^{g} ±0.06	4.81^{bc} ±0.01	4.86^{a} ±0.02	4.30^{k} ±0.05
12	4.34^{i} ±0.06	4.59^{e} ±0.08	4.73^{b} ±0.07	4.31^{k} ±0.09	4.41^{iJ} ±0.06	4.71^{e} ±0.04	4.80^{b} ±0.02	4.34^{L} ±0.08	4.42^{i} ±0.12	4.70^{e} ±0.04	4.83^{b} ±0.05	4.07^{m} ±0.06	4.43^{i} ±0.09	4.80^{c} ±0.02	4.85^{a} ±0.08	4.19^{m} ±0.11
16	4.21^{L} ±0.04	4.42^{h} ±0.07	4.68^{c} ±0.05	4.18^{m} ±0.03	4.34^{L} ±0.07	4.66^{g} ±0.05	4.74^{d} ±0.11	4.26^{n} ±0.12	4.38^{J} ±0.12	4.65^{f} ±0.11	4.77^{cd} ±0.08	3.91^{n} ±0.09	4.40^{J} ±0.06	4.76^{e} ±0.04	4.80^{c} ±0.05	4.03^{n} ±0.07

- Mean ± SD values having different superscript letters in columns and rows are significantly different ($p \leq 0.05$).

Conclusion:

The effect of using different concentrations of banana marmalade added and the storage period on the quality of yogurt made from cow's milk was studied. The starter was added at 5% after pasteurization of milk at 85 ° C for 10 minutes. The milk was incubated at 45 ° C for four hours, then it was cooled to 6 ± 2 ° C, then banana marmalade was added at concentrations of 5%, 10%, 15 and 20%, then sugar was added at a concentration of 8% for all levels of banana marmalade. Physiochemical characteristics, minerals, vitamins and sensory evaluation were all assessed over a storage period of 0, 4, 8, 12 and 16 days. Physiochemical analyzes of the engine yogurt showed that the highest solid value (36.0%), protein (4.91%), ash (1.81%), fat content (3.58%), carbohydrate (24.0%), fiber (1.71g / 100g) and energy (759.56) K. Cal.), It was obtained by the sample of treated yogurt 20%, with the least amount (21.2%) for solids, protein (4.21%), ash (1.42%). Fat content (3.16 0%), carbohydrate (12.22%), fiber (0.19 g / 100g) and energy (396.23K.Cal), obtained by the sample of treated yogurt 5% banana marmalade. Solids, protein, fat, ash, carbohydrates, fiber and energy are increased by increasing the proportion of banana marmalade. The pH value decreased significantly ($p \leq 0.05$) for all samples during the storage period. The highest value (4.71) for the sample was 20% banana marmalade, and the lowest (4.24) with 5%. The addition of banana marmalade decreased ($p \leq 0.05$) the pH level for all the yogurt samples. The titrated acidity increased significantly ($p \leq 0.05$) during the storage period, the highest value (1.21%) was obtained by the treated yogurt sample by 20% and the lowest (0.89%) with 5% banana marmalade. The intake of both minerals and vitamins increased as the level of banana marmalade increased. The sample with the highest percentage of calcium, phosphorous, sodium, potassium, iron, magnesium, vitamin E and vitamin C (25.2, 28.1, 393, 384, 238, 213, 1.02 and 21.3 µg

/ 100g, respectively) was obtained from the sample 20% banana marmalade, while The lowest value (17.2, 12.6, 134, 326, 104, 112, 0.23 and 9.21 microg / 100g, respectively) in the sample was 5%. The sensory evaluation revealed that the sample treated with 15% banana marmalade gave the best values for appearance characteristics (4.84), texture (4.88), flavor (4.86) and general acceptance (4.86). Storage period affected the quality of the yogurt. The four sensory evaluation parameters gave the best values on the eighth day of the storage period and the lowest at the end.

References

(1) Abdel-Salam, M.H.; El-Etriby, H.M. and Nadia M.S. (1996). Influence of some stabilizers on some chemical and physical properties of yoghurt, *Egyption Dairy Sci*., 24: 25-36.

(2) Ahmed, S.K.; Haroun, E. and Eisa, M.O. (2010) Banana Frozen Yoghurt from camel Milk, *Pakistan Journal of Nutrition*, 9(10): 955-956.

(3) Bashir, A. M. (2010). Effect of types of acacia gum and storage period on quality of set yoghur. M.Sc. Thesis in Food Science and Technology. University of Al-Zaiem Al-Azhari. Sudan.

(4) Chen, J. Y.; Piva, M. and Labuza, T. P. (1984), Evolution of water binding capacity (WBC) of food fiber sources, *J. Food Sci.*49:59-63.

(5) El-Shibiny, S.; El Dieeb, H.F. and Hofi, A.A. (1987). Effect of storage on the chemical composition of yoghurt. *Egyption J. Food Sci*., 7(1):1-7 Cited on DSA , 41(12):Abst. No. 8009.

(6) Fligner, K.; Lindamood, J.B. and Hansen, P.M.T. (1988) Fortification of low-fat plain yoghurt with calcium gluconate. *Cultured Dairy Prod*. 23:5–9.

(7) Galal, E.A.; Aly, S.A. and Elewa, N.E. (2004). Fruit yoghurt sensory, chemical, microbiology properties and consumer acceptance. *Pakistan J. Nutr*., 3(6):322-330.

(8) Ghada, Z. A. S. (2002). Comparison of chemical and mineral content of milk from human, cow, buffalo, camel and goat in egypt. lecturer of biochemistry, Biochemistry Department, National Nutrition Institute, *Egyptian Journal of Hospital Medicine,* 116 – 130, Cairo.

(9) Gouda, A.; Mohammed, A. and Ali, W.A. (2004). Technological aspects to improve frozen yoghurt quality. *Egyptian J. Dairy Sci*., 32(1):99-110.

(10) Hafiz, Z. A. (2013). Effect of levels of banana powder on quality of set yoghurt made from camel milk. M.Sc. Thesis in Food Science and Technology. University of Al-Zaiem Al-Azhari. Sudan.

(11) Hashim, I. B.; Khalil, A. H.; and Afifi, H. S. (2009). Quality characteristics and consumer acceptance of yoghurt fortified with date fiber. *Journal of Dairy Science*, 92(11):5403−5407.

(12) Syvaoja, E. L.; Pironen, V.; Varo, P.; Koivistoinen, P. and Salminen, K. (1985). Tocopherols and tocotrieols formulas. *International journal for Vitamin and Nutrition Research.* 55:159-166.

(13) Hofi, A. A.; El-Dien, H. and El-shibing, S. (1978) The yoghurt: chemical composition of market yoghurt. *Egyptian J. Dairy Sci*., 6:25-31.

(14) Hull, R.R.; Roberts, A.V. and Mayes, J. J. (1984) Survival of Lactobacillus acidophilus in yoghurt. *Australian J. Dairy Technol*., 39:164-166.

(15) Ihekoronye, A. I. and Ngoddy, P.O., (1985), Integrated food since and technology for the tropics. *Mac.Millan.pub*. london.

(16)James, C. S. (1995), Analytical Chemistry of Foods, Analytical chemistry of foods (1st ed.), Glasgow, UK: Blackie Academic & Professional.
(17)Keogh, M. K. and O'Kennedy, B. T. (1998). Rheology of stirred yoghurt as affected by added milk fat, protein and hydrocolloids. *Journal of Food Science*, 63(1):108-112.
(18)Lisazoian, L. and Joarusti, L. (1995), SPSS for windows, version 6.0, Buenos Aires: Editorial Paraninfo.
(19)Mata, J.; Curado, S.; Ephrussi, A. and Rorth, P. (2000). Tribbles coordinates mitosis and morphogenesis in Drosophila by regulating string/CDC25 proteolysis.
(20)Foda, M. I; Abd El- Aziz, M. and Awad, A.A. (2007). Chemical, Rheological and Sensory evaluation of yoghurt supplemented with tumeric. *International J.Dairy*, 2(3):252- 259.
(21)Morvarid, Y.; Leila, N. and Elham, A. (2013). Effect of different concentration of fruit additives on some physicochemical properties of yoghurt during storage. Scholars Research Library. , 4 (4):244-249.
(22)Nelson, S.C.; Ploetz, R.C. & Kepler, A.K. (2006). "Musa species (bananas and plantains)". In Elevitch, C.R. Species Profiles for Pacific Island Agroforestry. Hōlualoa, Hawai'i: Permanent Agriculture Resources (PAR).
(23)Öztürk B. A. and Öner M. D. (1999). Production and evaluation of yoghurt with concentrated grape juice. Institute of Food Technologists. *Journal of Food Science*. 64:3.
(24)Peiman, A.; Mehran, M. and Rabehe, I. M. (2011), The production of fruity yoghurt with banana flavour, International Conference on Environmental Science and Technology, 2(6): 368-370.
(25)Pirkul, T.; Temiz, A. and Erdem, Y. K. (1997), Fortification of yoghurt with calcium salts and its effect on starter microorganisms and yoghurt quality. *Int. Dairy J*. 7:547–552.
(26)Ploetz, R.C.; Kepler, A.K.; Daniells, J. & Nelson, S.C. (2007). "Banana and Plantain: An Overview with Emphasis on Pacific Island Cultivars". In Elevitch, C.R. Species Profiles for Pacific Island Agroforestry. Hōlualoa, Hawai'i: Permanent Agriculture Resources (PAR).
(27)Prekin Elmer (1994). Analytical methods for Atomic Absorption Spectrometry. Perkin Elmer Corporation,761 Main Ave., Norwalk,CT0659-0012 U.S.A.
(28)Salji, J. P.; Fawal, A. K.; Saadi, S. R.; Ismail, A. A. and Mashhadi, A. (1985). Effect of processing and compositional parameters on quality of plain liquid yoghurt. *Milchwissenchaft*., 40:734-736.
(29)Singh, G. and Muthukumarappan, K. (2008) Influence of calcium fortification on sensory, physical and rheological characteristics of fruit yoghurt. *Lebensm. Wiss. Technol*.;41:1145–1152.
(30)Songul, C.; Bulent, C.; Tamer, T.; Mustafa, G. and Ahmed, A. (2010), Probiotic properties, sensory qualities, and storage stability

of probiotic banana yoghurts, *Turk. J. Vet. Anim. Sci.* 36(3): 231-237.
(31)USDA (2010), Dietry guidelines for Americans, 7th Edition, *Washington*, DC: U.S. Government Printing Office.
(32)Valmayor, R. V.; Jamaluddin, S.H.; Silayoi, B.; Kusumo, S.; Danh, L.D.; Pascua, O. C. and Espino, R. R. C. (2000). Banana cultivar names and synonyms in Southeast Asia. Los Baños, Philippines: International Network for Improvement of Banana and Plantain – Asia and the Pacific Office. ISBN 978-971-91751-2-4. Archived from the original on 2013-01-08.
(33)Yousef, G. G.; Grace, M. H.; Medina, J. L.; Neff, S.; Guzman, I. and Brown, A. F. (2013). Concentrating immunoprotective phytoactive compounds from fruits and vegetables into shelf- stable protein- rich ingredients. *Plant Foods Hum. Nutr*. 69:317 – 324 .